US005980220A

United States Patent [19]

Mazzucato et al.

[11] **Patent Number: 5,980,220**

[45] **Date of Patent: *Nov. 9, 1999**

[54] **VERTICALLY MOUNTED HIGH PRESSURE WATER PUMP**

[76] Inventors: **Robert Mazzucato**, via Dario Papa, 4G, Milan; **Carlo A. Cuneo**, via Castello, 11, Crema, both of Italy; **Gus Alexander**, 1535 Freeman Rd., Hoffman Estates, Ill. 60195

[*] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: **08/899,784**

[22] Filed: **Jul. 24, 1997**

Related U.S. Application Data

[62] Division of application No. 08/516,496, Aug. 17, 1995, Pat. No. 5,653,584.

[51] **Int. Cl.**[6] **F04B 17/00**

[52] **U.S. Cl.** **417/360**; 417/364

[58] **Field of Search** 417/360, 364, 417/221, 531, 533

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,653,584 8/1997 Mazzucato et al. 417/360

Primary Examiner—Charles G. Freay
Attorney, Agent, or Firm—Leydig, Voit & Mayer, Ltd

[57] **ABSTRACT**

A vertically oriented high pressure water pump system including a vertically oriented motor, an intermediate flange and an axial drive water pump wherein the intermediate flange verticaly unites the motor and the high pressure water pump and further includes an axial thrust bearing and a thrust bearing sleeve for coupling the motor drive shaft in the axial drive pump.

17 Claims, 5 Drawing Sheets

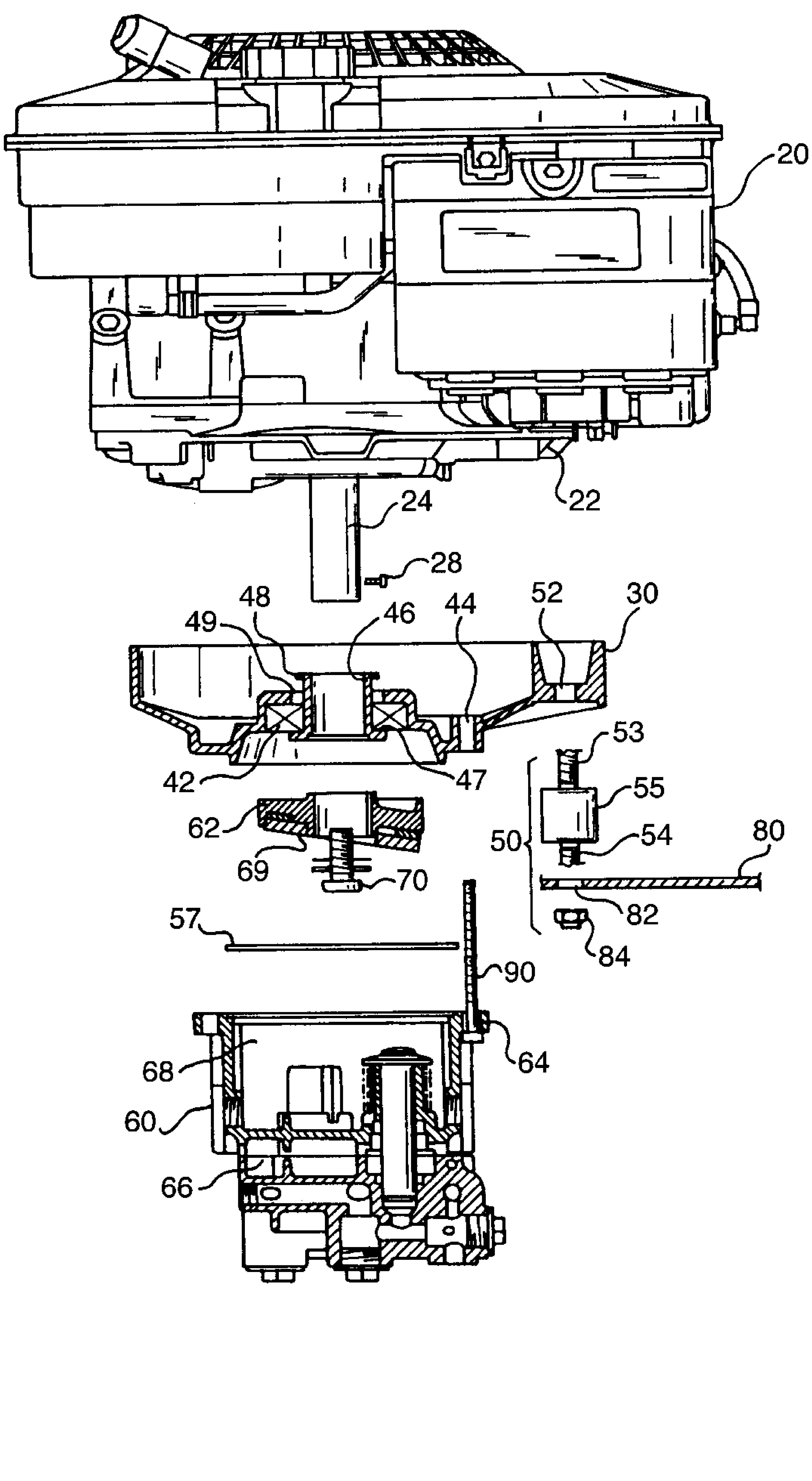
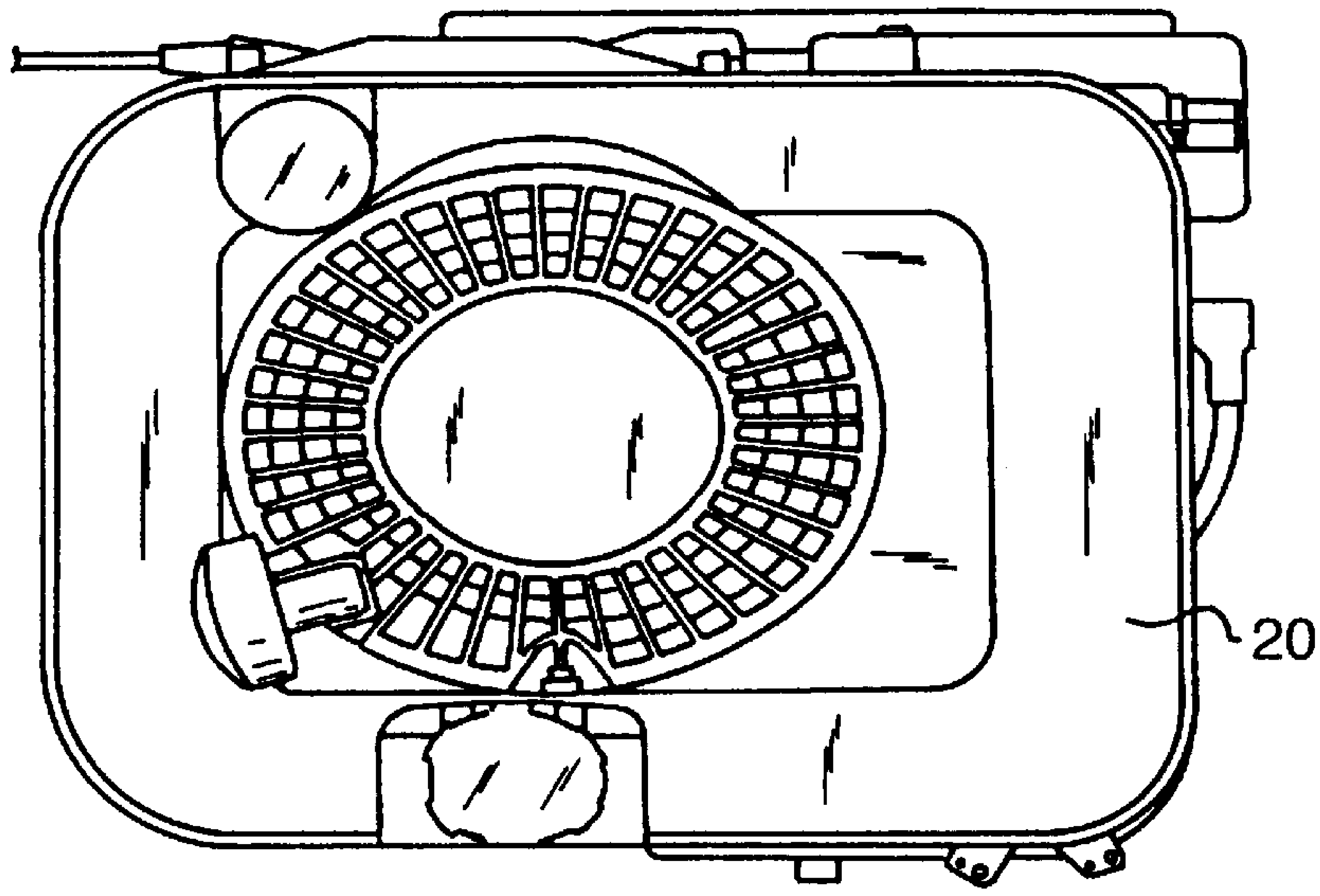


FIG. 1B



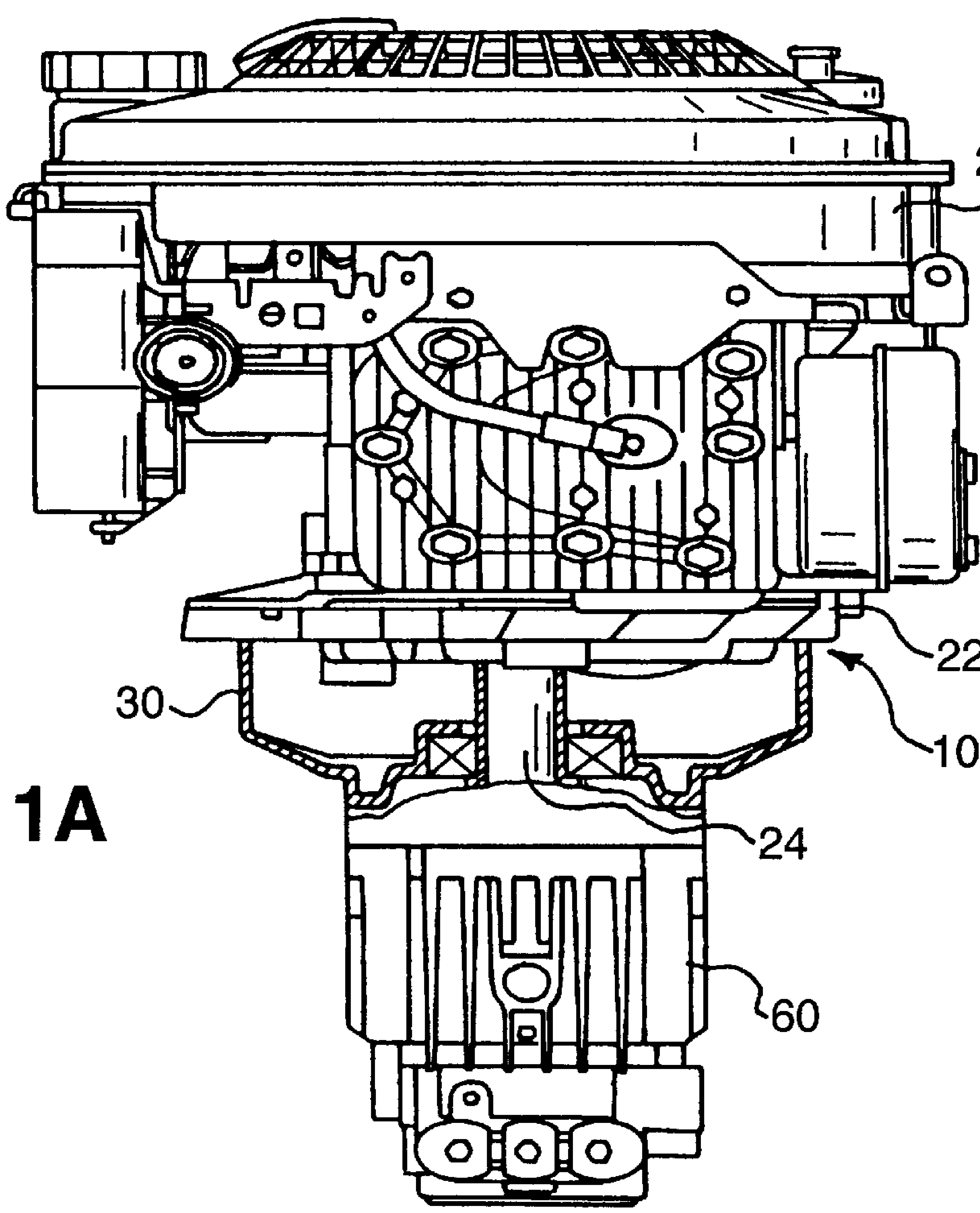


FIG. 1A

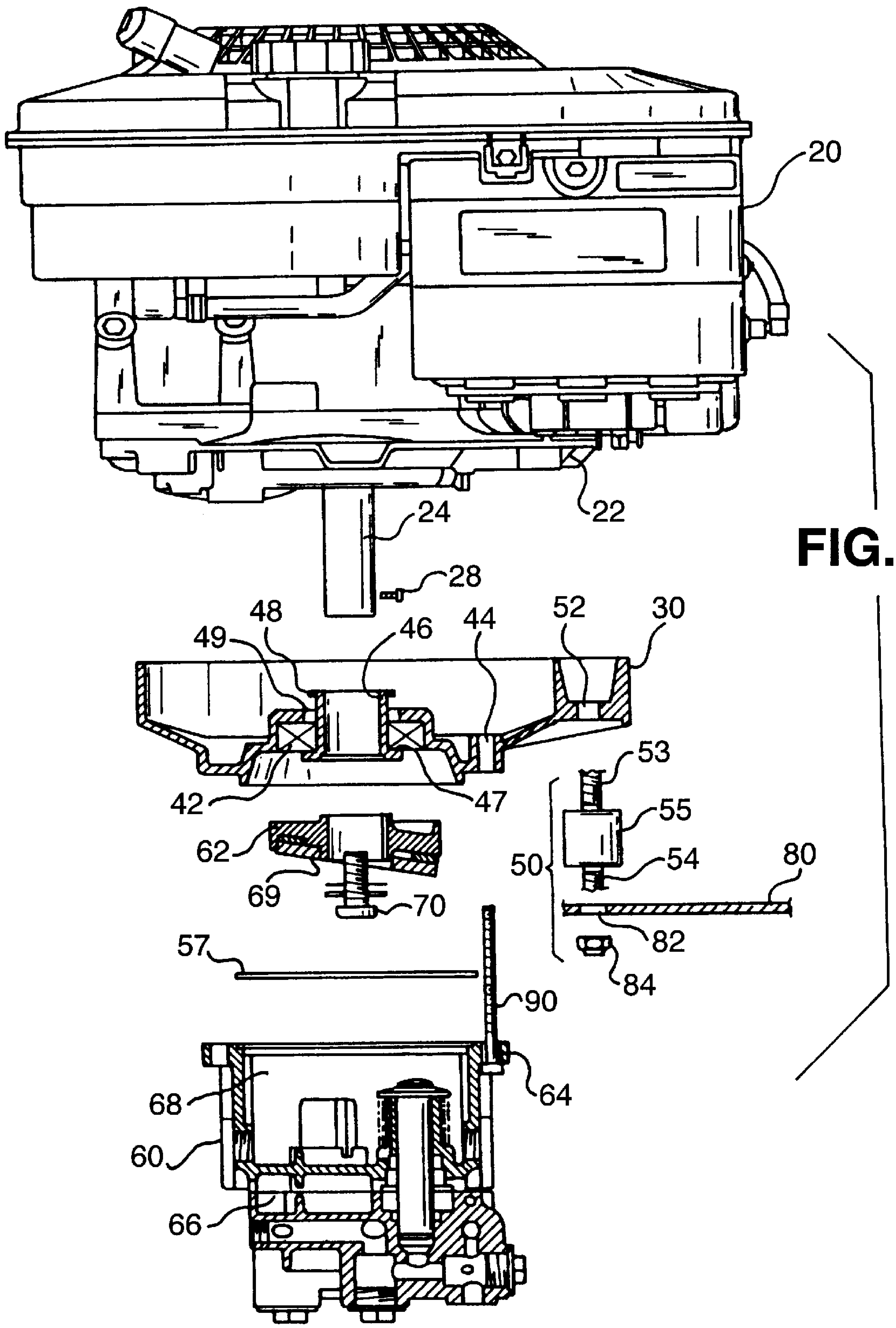

20
22
24
28
48
49
46
44
52
30
42
47
53
55
50
54
80
62
69
70
82
57
84
90
64
68
60
66

FIG. 2

FIG. 3C

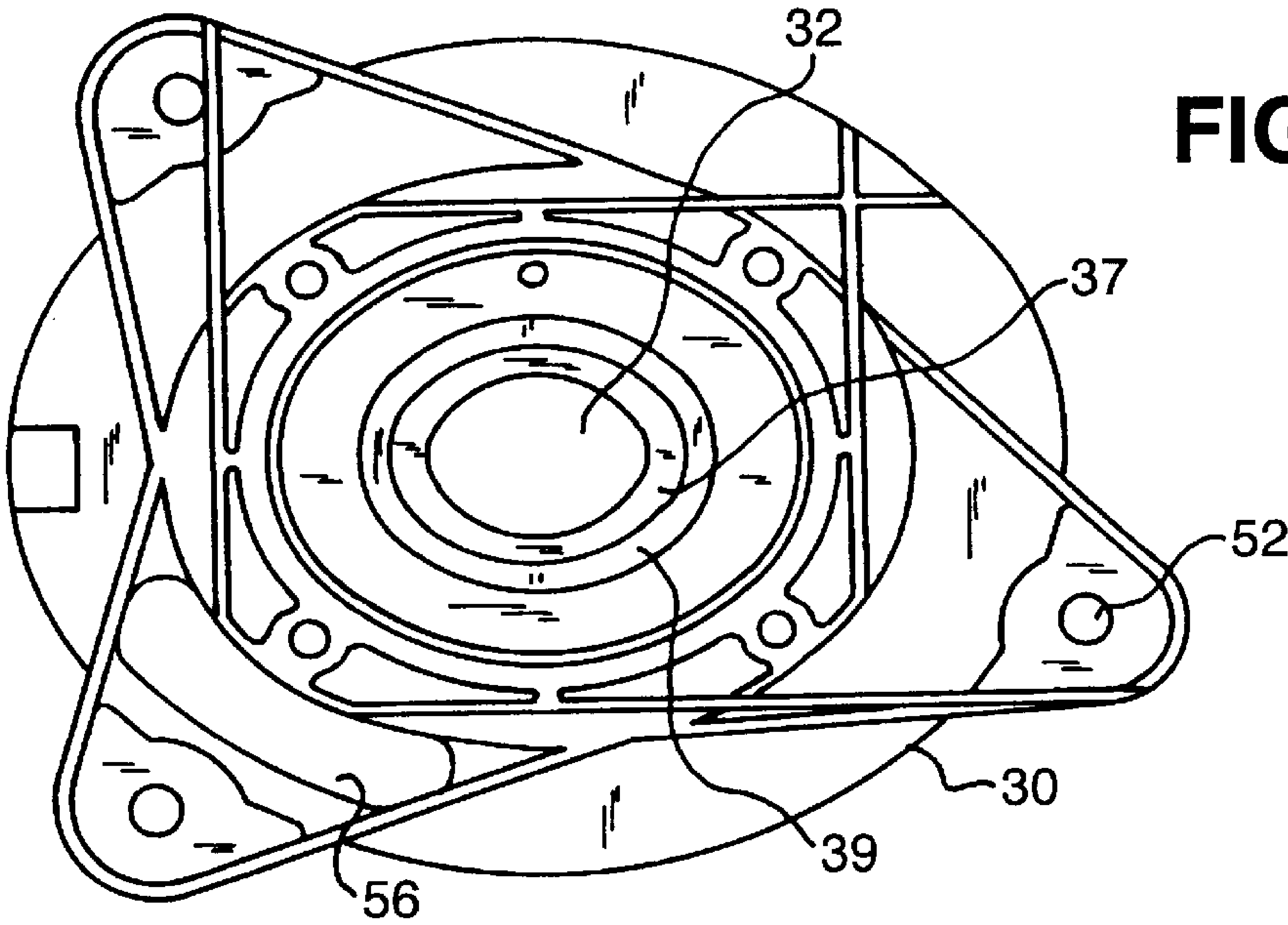


FIG. 3B

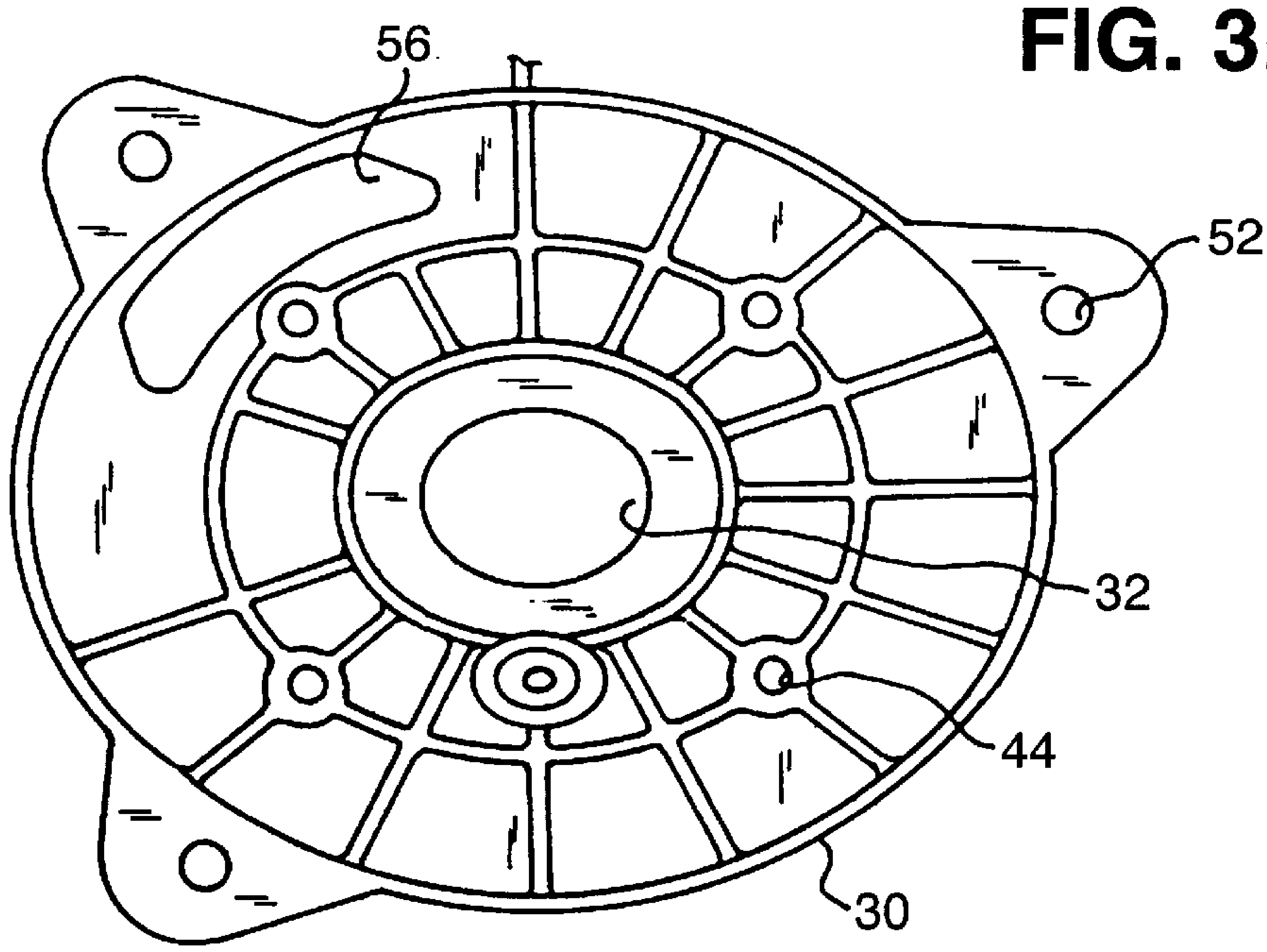


FIG. 3A

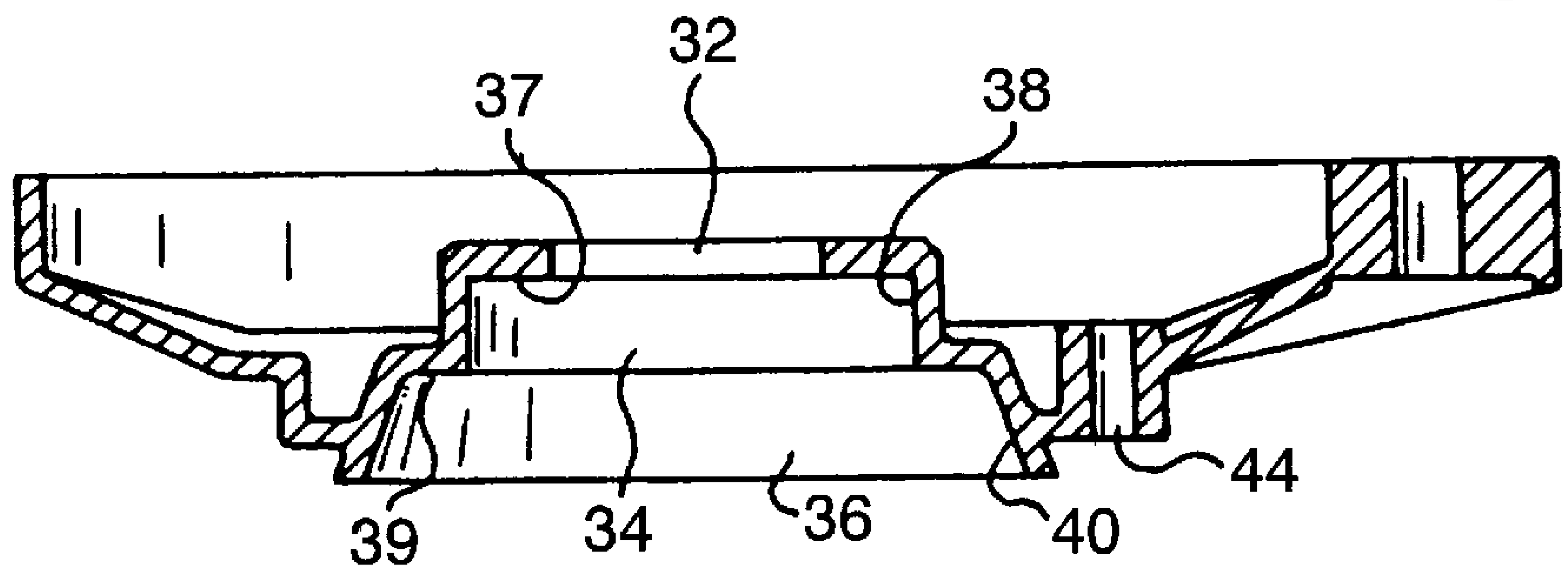


FIG. 4

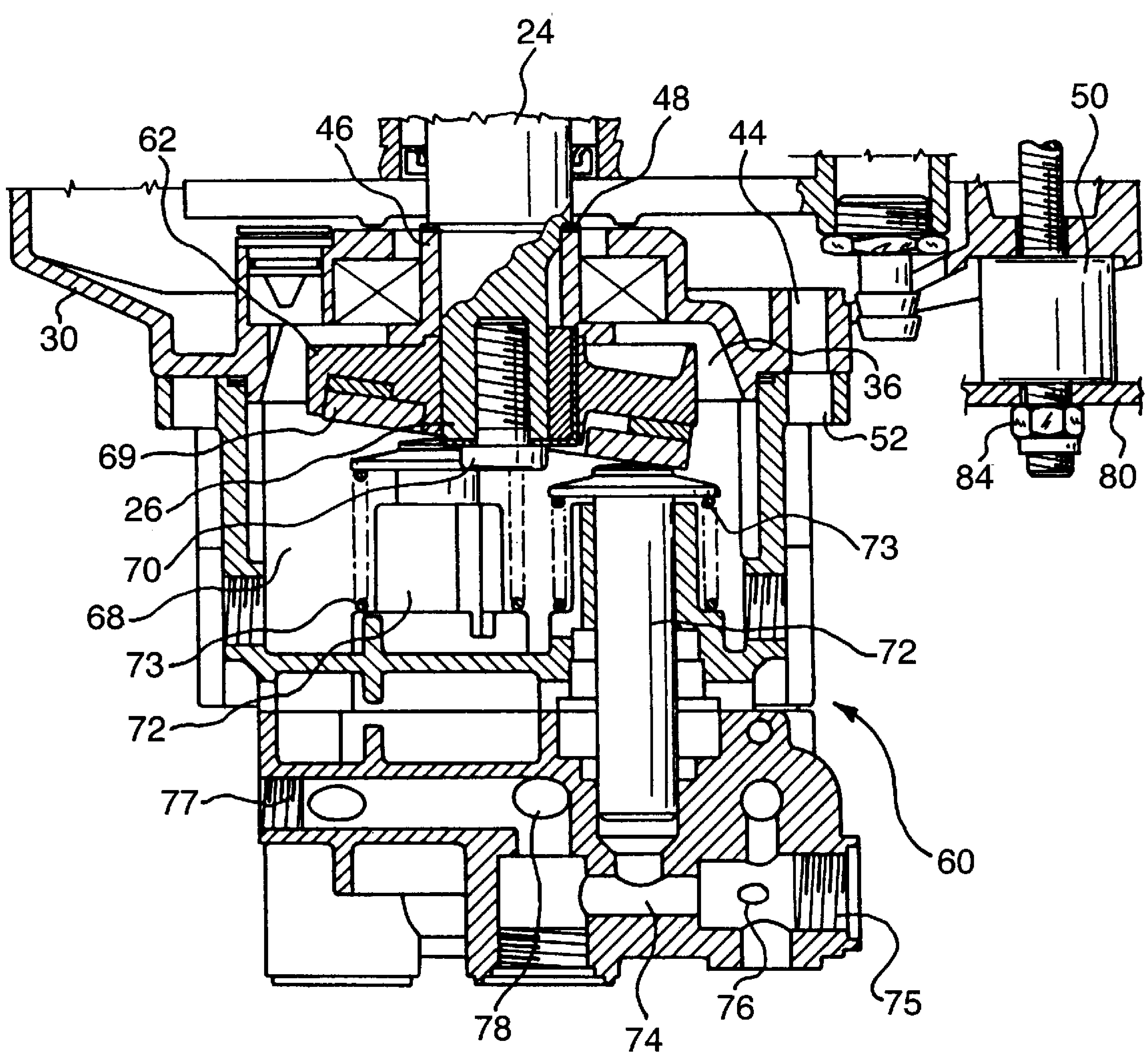
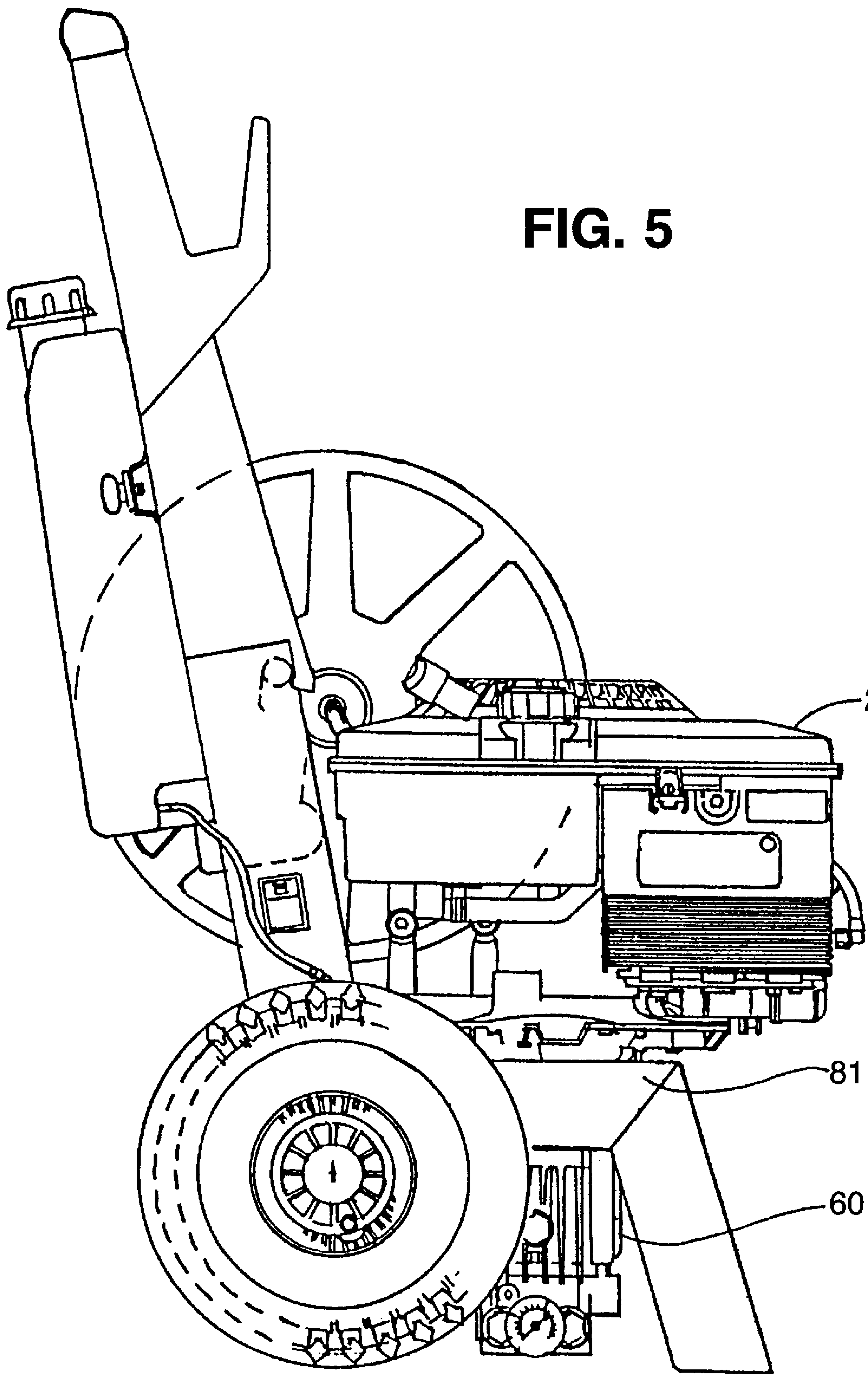

24
48
50
62
46
44
30
36
52
69
84
80
26
73
70
68
72
73
72
77
60
78
74
76
75

FIG. 5



VERTICALLY MOUNTED HIGH PRESSURE WATER PUMP

This is a divisional of application Ser. No. 08/516,496, filed Aug. 17, 1995, now U.S. Pat. No. 5,653,584.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

This invention concerns a high pressure water pump system that is designed to be driven with a standard vertically mounted motor like those used to power consumer lawn mowers. The high pressure water pump system uses an intermediate flange, including an axial thrust bearing, to unite the vertically mounted motor to an axial driven pump. The high pressure water pump system may optionally include vibration dampeners located between the intermediate flange and a horizontal platform to reduce motor noise and vibrations.

(2) Description of the Art

Small high pressure water pumps driven by motors are well known in the art. For example, U.S. Pat. No. 5,395,062 describes a high pressure cleaning device where the motor, including the motor drive shaft, is horizonatally oriented.

Other commercially available high pressure water pump systems include horizontally mounted motors, or include vertically mounted motors that include a shaft sleeve that is eliminated by the intermediate flange used in the pump system of this invention.

SUMMARY OF THE INVENTION

Small, reliable high pressure water pump systems are gaining popularity among consumers. Presently available high pressure water pump systems are inexpensive, reliable, compact, and easy to use. They are also useful for a variety of purposes, some of which include washing automobiles and home sidings. The majority of high pressure water pump systems purchased by consumers are horizontally oriented because conventional motors used in high pressure water pump systems must typically be associated with gear reducers or shaft sleeves in order to efficiently operate the pump using a rotating motor drive shaft. This makes the pump system quite long and, therefore, awkward for vertical mounting.

It is an object of this invention, therefore, to provide a vertically oriented high pressure water pump system that is shorter in length than conventional high pressure water pump systems.

It is another object of this invention to provide a vertically oriented high pressure water pump system that is compatible with standard consumer motors such as internal combustion or electric motors used in consumer lawn mowers.

It is yet another object of this invention to provide a vertically oriented high pressure water pump system that includes an axial thrust bearing associated with an intermediate flange that allows the drive shaft of a vertically oriented motor to be directly connected to an axially driven pump.

In one embodiment, this invention is a vertically oriented high pressure water pump system. The vertically oriented high pressure water pump system includes a motor having a motor housing and a downwardly oriented vertical drive shaft. The pump system also includes an axial drive pump that is driven by the motor drive shaft. An intermediate flange is positioned between the motor and the pump. The intermediate flange includes an aperture and a first recess. A means for uniting the pump and motor compressively fixes the intermediate flange between the motor and the axial drive pump. An axial thrust bearing is located in the first recess of the intermediate flange. A drive shaft sleeve is attached to the drive shaft and the drive shaft sleeve is at least partially surrounded by the axial thrust bearing so that rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison thereby driving the pump.

In another embodiment, this invention is a vertically oriented high pressure water pump system including an internal combustion engine, an axial drive piston pump and an intermediate flange where the pump system is associated with a horizontal platform. The pump system engine includes a motor housing and a downwardly oriented vertical drive shaft. An intermediate flange having an aperture, a first recess, a second recess, and a plurality of first bolt apertures spaced at 120° intervals around the circumference of the intermediate flange is positioned between the motor and the axial drive piston pump. An axial thrust bearing is fixedly located in the first recess of the intermediate flange and the drive shaft sleeve is attached to the drive shaft and at least partially surrounded by the axial thrust bearing so that rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison. The axial drive piston pump includes a plurality of second bolt apertures complementary to the first bolt apertures. A bolt is passed through each first and second bolt aperture and tightened to compressively secure the intermediate flange between the engine and the axial drive piston pump. A wobble disc assembly is located in the second recess of the intermediate flange and it is attached to the end of the drive shaft. Drive shaft rotation causes the wobble disc to rotate which, in turn, drives the axial drive piston pump. The assembled pump system is attached to horizontal platform associated with a cart by way of a plurality of vibration dampeners. Each vibration dampener includes a first threaded end for attaching the vibration dampener to the horizontal platform and a second threaded end for attaching the vibration dampener to the intermediate flange.

DESCRIPTION OF THE DRAWINGS

There is shown in the drawings a presently preferred embodiment of the vertically oriented high pressure water pump system of the present invention wherein like numerals in the various figures pertain to like elements and wherein:

FIG. **1**A and **1**B are front and top schematic views, respectively, of an embodiment of a vertically oriented high pressure water pump system of this invention;

FIG. **2** is an assembly view of an embodiment of a high pressure water pump system of this invention including cut-away views of the intermediate flange and of an axial drive piston pump;

FIGS. **3**A, **3**B, and **3**C are side cutaway, top, and bottom views, respectively, of an intermediate flange useful in a vertically oriented high pressure water pump system of this invention; and

FIG. **4** is a side cutaway view of a type of axial drive piston pump that is useful in association with the vertically oriented high pressure water pump system of this invention.

FIG. **5** is a side view of and vertically oriented high pressure water pump associated with a wheeled horizontal platform.

It should be understood that terms used herein as "top", "bottom", "end", "first", "second", and "associated with" have reference only to the structures shown on the drawings as they would appear to a person viewing the drawings and are used merely to simplify the description of this invention. The figures are drawn to show the basic teachings of the present invention including the positional relationships of the parts that perform various functions of the invention. Unless explained in detail, the dimensional proportions, materials of construction and so forth are well within the understanding of those of skill in the art.

Description of the Current Embodiment

The present invention relates to a high pressure water pump system that is driven by a motor that is vertically mounted. By "vertically mounted" it is meant that the motor drive shaft must be oriented vertically and downwardly. A vertically oriented motor associated with an intermediate flange and an axial drive pump defines a pump system of this invention that is short and compact.

The vertically oriented high pressure water pump system of this invention is designated by the numeral **10** in the various figures. Pump system **10** includes a motor **20**, an axial drive pump **60**, and an intermediate flange **30** for uniting motor **20** with axial drive pump **60**. High pressure water pump system **10**, when assembled, is associated with a horizontal platform **80** so that the vertically oriented high pressure pump remains in a vertical position.

Referring now to FIGS. **1**A and **1**B, pump system **10** of this invention includes a motor **20** having a housing **22** and a vertically and downwardly oriented drive shaft **24**. Motor **20** may be any type of motor that is able to provide sufficient torque to operate axial drive pump **60**. It is preferred that motor **20** is an electric motor or internal combustion engine of the type used for consumer upright lawn mowers. Such motors are capable of generating between 3 horsepower and 10 horsepower allowing pump system **10** of this invention to generate from 1,500 to 4,000 psi of water pressure.

It is preferred that motor **20** is an internal combustion engine. It is important that the preferred internal combustion engine **20** remain vertically oriented. If the motor is tipped, then gasoline can leak from the motor causing safety problems. Thus, the preferred vertically oriented high pressure water pump **10** of this invention will be secured, vertically, in horizontal platform **80**.

Motor **20** is associated with drive shaft **24** and causes it to rotate axially. Intermediate flange **30** unites motor **20** and drive shaft **24** with pump **60** and allows drive shaft **24** to rotate while preventing non axial rotation or movement of drive shaft **24**. Intermediate flange **30** also aids in efficiently transferring the rotational power of drive shaft **24** to axial drive pump **60**.

An embodiment of intermediate flange **30** is shown in FIGS. **3**A, **3**B, and **3**C. Intermediate flange **30** includes an aperture **32** located approximately in the center of intermediate flange **30**. Intermediate flange **30** includes a first recess **34** and a second recess **36** which both include aperture **32**. First recess **34** and second recess **36** are coaxial to aperture **32**. First recess **34** is defined by first circumferential face **37** and first cylindrical wall **38** while second recess **36** is defined by second circumferential face **39** and second cylindrical wall **40**. First recess **34** is sized to accept axial thrust bearing **42**, while second recess **36** is sized to accept wobble disc assembly **62**.

Intermediate flange **30** is associated with motor **20** by any means known in the art for uniting a flange with a motor. It is preferred that intermediate flange **30** is removably and compressibly associated with motor **20** with bolts that pass from axial drive pump **60** into motor **20** via intermediate flange **30**. As shown in FIGS. **3**A–**3**C, intermediate flange **30** includes a plurality of first bolt apertures **44**, and preferably four first bolt apertures **44** located at intervals around the circumference of intermediate flange **30**.

Intermediate flange **30** is also removably attached to axial pump **60**. Intermediate flange **30** may be removably attached to pump **60** by any reversible attaching means known to one of skill in the art including, but not limited to bolts, a C-clamp and the like. It is preferred that pump **60** includes a plurality of pump bolt apertures **64** each complementary to an intermediate flange first bolt aperture **44**. In the preferred pump system **10**, bolt **90** is passed upwardly through pump bolt aperture **64**, through first bolt aperture **21** **44** and into a complementary threaded aperture **21** in motor **20**. As the plurality of bolts **90** are tightened, intermediate flange **30** is compressed between motor **20** and axial pump **60**. Alternatively, a first attaching means can be used to unite motor **20** and intermediate flange **30** while a separate second attaching means can be used to unite intermediate flange **30** with axial pump **60**. The first and second attaching means may be an attaching device known in the art for reversibly uniting two objects such as bolts, clamps, threaded connectors and the like. What is important is that intermediate flange **30** is reversibly secured between motor **20** and pump **60**.

As is shown in FIG. **2**, an axial thrust bearing **42** is located in the first recess **34** of intermediate flange **30**. Axial thrust bearing **42** abuts first circumferential face **37** and first cylindrical wall **38** and should fit snugly into first recess **34** so that the rotating portion of axial thrust bearing **42** rotates while the fixed portion does not. Axial thrust bearing **42** is cylindrical in shape and includes an aperture through which drive shaft sleeve **46** fits. Drive shaft sleeve **46** includes a shoulder **47** that abuts axial thrust bearing **42** and that prevents drive shaft sleeve **46** from passing entirely through the axial thrust bearing aperture. When associated with associated pump system **10** of this invention, axial thrust bearing **42** provides for the efficient axial transfer of rotational power from motor **20** to pump **60** while absorbing non axial stresses caused by the rotation of wobble disc assembly **62**.

Drive shaft sleeve **46** may be associated with axial thrust bearing **42** in any manner known in the art that will allow drive shaft sleeve **46** to rotate in unison with motor drive shaft **24** and with axial thrust bearing **42**. For example, drive shaft sleeve **46** may be press fit into the axial thrust bearing aperture, or it may be mechanically attached to axial thrust bearing **42**.

Similarly, drive shaft **24** may be associated with drive shaft sleeve **46** by any method known in the art that allows drive shaft **24** to rotate freely in conjunction with axial thrust bearing **42**. For example, drive shaft **24** may be press fit into drive shaft sleeve **46**, it may be adhesively associated with drive shaft sleeve **46**, or it may be mechanically associated with drive shaft sleeve **46**. It is preferred that drive shaft sleeve **46** is mechanically associated with drive shaft **24** using one or more set screws **28** passing perpendicularly through drive shaft sleeve **46** and into drive shaft **24**.

Intermediate flange **30** may include an optional first "O"-ring **48** that fits into a first "O"-ring recess **49** surrounding intermediate flange aperture **32**.

One or more vibration dampeners **50** may be associated with intermediate flange **30** and with horizontal platform **80**. Vibration dampeners **50** dampen any noise and vibration caused by motor **20** thereby stabilizing and protecting pump **60** and other pump system parts from mechanical fatigue. It is preferred that pump system **10** of this invention include at least three vibration dampeners **50** spaced at 120° intervals around the circumference of intermediate flange **30**.

In order to accomodate the preferred vibration dampeners, intermediate flange **30** includes a plurality of second bolt apertures **52**. Each vibration dampener **50** includes a first threaded end **53** and a second threaded end **54** divided by a dampening block **55**. Dampening block **55** may be manufactured from rubber, any synthetic rubber or rubber-like material, or out of any material known to one of skill in the art to be useful for vibration dampening. Each vibration dampener **50** is associated with pump system **10** directing first threaded end **53** of vibration dampener **50** through a second bolt aperture **52** and thereafter threading first threaded end **53** into a complementary threaded aperture in motor **20**. Next, second threaded end **54** is directed through a hole **82** in horizontal platform **80** and thereafter the vibration dampener **50** is secured to horizontal platform **80** with a complementary nut **84**.

Intermediate flange **30** may include an opening **56**. Opening **56** allows air to enter and exit from the space created when intermediate flange **30** is attached to motor **20** thereby helping to cool motor **20** and intermediate flange **30**. Opening **56** also provides an egress point for oil or gasoline that may seep from motor **20**.

A second "O"-ring **57** is preferably located at the point where intermediate flange **30** and pump **60** are united. Second "O"-ring **57** creates a seal that prevents the ingress and egress of materials to and from oil filled pump chamber **68** when intermediate flange **30** is compressively associated with pump **60**.

Pump system **10** of this invention includes an axial drive pump **60**. Any type of axial driven pump **60** may be used with this invention. It is preferred, however, that pump system **10** includes an axial drive piston pump.

FIG. **4** is a front cutaway view showing various elements of a preferred axial drive piston pump **60** useful in the pump system of the invention. While an understanding of the precise operation of the preferred axial drive piston pump **60** is not necessary to allow one of skill in the art to practice this invention, an explanation of the operation of the preferred axial drive piston pump **60** is included for a complete understanding of the vertically oriented high pressure water pump system **10** of this invention.

Axial drive piston pump **60** is contained within pump housing **66** and includes an oil filled pump chamber **68** containing three piston **72**. Pump **60** includes a wobble disc assembly **62** that further includes an eccentric plate **69** attached to end **26** of drive shaft **24**. Wobble disc assembly **62** may be attached to end **26** of drive shaft **24** by any means known in the art. A preferred attaching method is a screw **70** that passes partially through wobble disc assembly **62** and into a threaded aperture at end **26** of drive shaft **24**.

Wobble disc assembly **62** fits into second recess **36** of intermediate flange **30**. Unlike axial thrust bearing **42**, however, wobble disc assembly **62** does not touch intermediate flange **30** but, instead, freely rotates within second recess **36**.

Wobble disc **62** actuates pump **60** via the rotation of drive shaft **24**. Rotations of drive shaft **24** causes wobble disc assembly **62** to rotate around a fixed axis. Eccentric plate **69** continuously contacts a plurality of pistons **72** associated with pump **60** and rotation of wobble disc assembly **62** also rotates eccentric plate **69**. As its name implies, eccentric plate **69** rotates in a non-planar, eccentric manner with respect to pistons **72** thereby causing each of the plurality of pistons **72** to go through a full range of vertical motion for each rotation of eccentric plate **69**.

As eccentric plate **69** rotates, it moves piston **72** away from motor **20** and towards pump **60** thereby causing water to flow through outlet check valve **78** and through outlet port **77**. Upon further rotation, eccentric plate **69** begins to move towards motor **20** and away from piston **72** causing spring **73** to urge piston **72** away from water flow chamber **74** and towards eccentric plate **69** thereby drawing water into inlet port **75** and through inlet check valve **76**. Upon further rotation, eccentric plate **69** once again urges piston **72** towards water flow chamber **74** causing the water pressure in the chamber to increase and water once again flows through check valve **78** and outlet port **77**. The preferred pump **60** axial drive piston includes three pistons which operate in unison but out of phase to produce a constant high pressure stream of water.

Horizontal platform **80** may be any type of platform capable of supporting the vertically oriented high pressure water pump system **10** of this invention. Horizontal platform **80** may be a fixed platform such as a bench or a table or it can be a wheeled horizontal platform **81**, as shown in FIG **5**.

The description above has been offered for illustrative purposes only, and it is not intended to limit the scope of the invention of this application which is defined in the following claims.

What I claim is:

1. A vertically oriented high pressure water pump system comprising:

an motor including a motor housing and a downwardly oriented vertical drive shaft;

an axial drive pump driven by the drive shaft;

an intermediate flange between the axial drive pump and the motor and including a first recess;

an axial thrust bearing located in the first recess of the intermediate flange; and

a drive shaft sleeve attached to the drive shaft and at least partially surrounded by the axial thrust bearing such that rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison.

2. A vertically oriented high pressure water pump system comprising:

a motor including a motor housing and a downwardly oriented vertical drive shaft;

a pump driven by the drive shaft;

an intermediate flange interposed between said motor housing and said pump, said intermediate flange including a first recess;

an axial thrust bearing located in the first recess of the intermediate flange; and

a drive shaft sleeve attached to the drive shaft and at least partially surrounded by said axial thrust bearing such that rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison.

3. The vertically oriented high pressure water pump system of claim **2**, including a horizontal platform upon which said pump is mounted.

4. The vertically oriented high pressure water pump system of claim **2**, in which said pump is an axial drive piston pump.

5. The vertically oriented high pressure water pump system of claim **2**, including a plurality of connectors securing said intermediate flange to said motor housing.

6. The vertically oriented high pressure water pump system of claim **5**, in which said connectors are bolts.

7. The vertically oriented high pressure water pump system of claim **2**, in which a plurality of connectors secure said pump to said intermediate flange.

8. The vertically oriented high pressure pump system of claim **2**, in which said motor is an internal combustion engine.

9. A vertically oriented high pressure water pump system comprising:

an internal combustion engine including a motor housing and a downwardly oriented vertical drive shaft having an end;

an intermediate flange having an aperture, first and second annular recesses, and a plurality of first bolt apertures;

an axial thrust bearing located in the first recess of the intermediate flange;

a drive shaft sleeve attached to the drive shaft and at least partially surrounded by the axial thrust bearing such that the rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison;

an axial drive piston pump including a plurality of second bolt apertures complementary to the first bolt apertures;

a bolt associated with each first and second bolt aperture for compressively securing the intermediate flange between the motor and the axial drive piston pump; and

a wobble disc assembly for driving the axial drive piston pump located in the second recess for the intermediate flange and attached to the end of the drive shaft.

10. The vertically oriented water pump system of claim **9**, including a horizontal platform upon which said pump system is mounted.

11. The vertically oriented high pressure water pump system of claim **10**, including a plurality of vibration dampeners which support said pump system on said platform.

12. The vertically oriented high pressure water pump system of claim **11**, in which said vibration dampeners are spaced at intervals around the circumference of the horizontal platform.

13. The vertically oriented high pressure water pump system of claim **12**, in which said horizontal platform is wheeled.

14. The vertically oriented high pressure water pump system of claim **9**, wherein the first and second bolt apertures are spaced at intervals around the circumference of the high pressure water pump system.

15. A vertically oriented high pressure water pump system comprising:

an internal combustion engine including a motor housing and a downwardly oriented vertical drive shaft having an end;

an intermediate flange having an aperture, a first recess, a second recess and a plurality of first bolt apertures spaced at 120° intervals around the circumference of the intermediate flange;

an axial thrust bearing fixedly located in the first recess of the intermediate flange;

a drive shaft sleeve attached to the drive shaft and at least partially surrounded by the axial thrust bearing such that the rotation of the drive shaft causes the thrust bearing and the drive shaft sleeve to rotate in unison;

an axial drive piston pump including a plurality of second bolt apertures complementary to the first bolt apertures;

a bolt associated with each first and second bolt aperture for compressively securing the intermediate flange between the motor and the axial drive piston pump;

a wobble disc assembly located in the second recess of the intermediate flange and attached to the drive shaft end for driving the axial drive piston pump; and

a horizontal platform and a plurality of vibration dampeners each having a first threaded end associated with the horizontal platform and a second threaded end associated with the intermediate flange, the vibration dampeners securing the high pressure pump assembly to the horizontal platform.

16. The vertically oriented high pressure water pump of claim **15**, wherein the horizontal platform is wheeled.

17. The vertically oriented high pressure water pump of claim **16**, wherein three vibration dampeners located at intervals around the circumference of the intermediate flange connect the high pressure pump system to the horizontal platform.

* * * * *